USING VIRTUAL REALITY MODELLING IN CULTURAL MANAGEMENT, ARCHIVING AND RESEARCH

Joanne Tompkins
EMSAH
University of Queensland
St Lucia 4072
Brisbane
Australia
j.tompkins@uq.edu.au
http://www.ortelia.com

Matt Delbridge
Drama Department
Queen Mary, University of London
Mile End
E1 4NS
m.delbridge@qmul.ac.uk

Abstract – This paper outlines how the Ortelia project's 3D virtual reality models have the capacity to assist our understanding of sites of cultural heritage. The VR investigation of such spaces can be a valuable tool in 'real world' empirical research in theatre and spatiality. Through a demonstration of two of Ortelia's VR models (an art gallery and a theatre), we suggest how we might consider interpreting cultural space and sites as contributing significantly to cultural capital. We also introduce the potential for human interaction in such venues through motion-capture to discuss the potential for assessing how humans interact in such contexts.

This presentation outlines the Ortelia project, a virtual reality modelling project which creates 3D virtual reality models of real cultural spaces. The investigation of such spaces through a virtual lens can be a valuable tool in 'real world' empirical research in theatre and spatiality. We discuss two Ortelia VR models: an art gallery exhibition in contemporary Australia and a model of a Renaissance theatre in London that is no longer extant. We also extend this spatial discussion to the possibilities for adding motion capture files of humans engaging in and with such cultural environments. Finally, we outline some of the practical factors that such models present, before concentrating on how virtual recreations of cultural space assist our understanding and interpretation of space and culture. Our attempt is to find a way to put theoretical spatial concepts into practice in analysing spaces or venues of cultural significance. While one of the venues demonstrated is a 'real world' venue, the other is a historical venue that no longer exists. The methods for creating these two venues virtually may be different, but the significance of their cultural context does not, and neither does the theory with which they intersect.

While VR research for this project began as a theoretical question in theatre studies, it has broadened significantly to issues of space throughout several cultural contexts. Serendipitously, the context that we've developed for the investigation of *theatre* space turns out to be useful in other cultural spaces; this has led to a realisation that those pragmatic 'overlaps' might provide a theoretical provocation to reconsider the 'separateness' of domains of cultural space. If nothing else, they point to methods for managing and archiving cultural space(s) for public engagement and consumption.

In this context, 'space' means the various social, cultural, visual, and architectural factors, elements, and motives that converge or clash at any one point. As Henri Lefebvre, the author of *The Production of Space*, notes, "*We are confronted not by one social space but by many – indeed, by an unlimited multiplicity or uncountable set of social spaces which we refer to generically as 'social space'* " [1].

This investigation of theatre space takes place through Ortelia (http://www.ortelia.com), a project which recreates models of real venues in virtual reality form. Ortelia – named after Abraham Ortelius, the geographer and mapmaker who compiled the first atlas, called *Theatrum Orbis Terrarum* [2] – has its roots in theatre. We began creating detailed virtual reality models of theatres in Brisbane, Australia, in order to find a means of discussing practical space theoretically. Ortelia's precisely-scaled reproductions allow the investigation of theatre space without needing to be physically present in the building. Physical access to theatres is not regularly available to researchers: even when theatres are not housing a current production's set, they are subject to occupational health and safety regulations that preclude frequent visits. We originally worked with Brisbane-based scenographers to create set designs in VR, instead of using traditional paper diagrams and/or model boxes. Users could generate full set designs by selecting and scaling objects, then changing textures and colours, before modifying, saving, and sending their work to other users. At the time (almost 10 years ago), however, theatre was not the forum to adopt virtual models in a functional manner for a variety of reasons. Instead, we turned to art galleries and museums, cultural sites that have long since engaged with interactive exhibitions.

An Ortelia environment begins with a 3D model of a venue, built up from the geometry and dimensions of the actual site, covered with detailed images of the requisite surface textures. The models show a high degree of detail, down to the position of electrical outlets, light switches, and other such essential functional features of an indoor cultural space. They also demonstrate a venue's aesthetic features such as paint, stonework and the like. A model is generally prepared 'empty,' that is, without an exhibition in place. It is then a simple matter to place the pieces to recreate an entire exhibition. It is equally simple to replace the pieces for a subsequent exhibition, while archiving the original. We have almost completed a curation tool to enable curators to prepare a fully-visualised hanging-plan for an exhibition.

Among the models we have are art gallery sites, theatres, and a museum. The first model for demonstration is the *Our Way* exhibition, curated by Sally Butler, at the University of Queensland's Art Museum (May-July 2007). This landmark exhibition depicted the work of a group of Aboriginal painters from Lockhart River in Far North Queensland. Their style is very different from the conventional dot paintings with which you might be familiar. The virtual model of this exhibition preserves *Our Way* in its entirety in a very lightweight format (the full gallery models are under 20 MB). Selected pieces of this exhibition subsequently toured to Singapore and two locations in the US. The ability to retain a virtual model of the entire exhibition, in situ, at the very least enables visitors at other locations to see the art in different contexts and to engage with the pieces that did not travel.

Users can wander through the models in any order, pausing to examine the art and to read the label next to the image, or to view the sight lines from any number of locations, even those perspectives that would be all but physically impossible in an actual venue. Objects and images can be viewed straight on, or at an angle; three-dimensional objects in a collection can be rendered for full 360 degree viewing. While the models demonstrated here do not have pre-set paths, such tools are easily incorporated to guide patrons through an exhibition in a particular order, following, say, a chronological or thematic sequence. The models keep the paintings or items in the context of the exhibition or venue: that is, they are not just stored as thumbnails or pdf images in a database. The models are also easy to use, employing familiar interactive gaming technology tools (the W-A-S-D and arrow keys, plus a mouse).

The theatre model for demonstration is a re-creation of the long-since demolished Boar's Head Playhouse in Whitechapel, from its 1599 incarnation, the same year that the original Globe Theatre was built. It was created for Richard Fotheringham, to test his theories about the relationship between actors and audience in early modern theatre. Fotheringham commissioned this model to help him answer his questions about theatre historiography, including the physical relationship between audience and actor, and the artistic and social effects of this relationship. The model provides three different possible heights for the stage, and several different indications of where the doors at the back of the stage might have been. It is possible to consider which stage-height would have been most likely *and* the how the height of the stage might affect the position of the doors. The model also permits the user to walk along the gallery levels, because Fotheringham wanted to work out which owner of which building forming this inn-yard theatre would have managed to collect admission fees. Specifically, he is interested in:

the extent to which audiences respect (or don't respect) the boundary between the space the actors occupy, and the space into which the audience is directed and invited to stand. […] To what extent is the edge of the stage a boundary between the performance space and the audience space, and does this also serve as the "edge" to the imagined world of the dramatic narrative? [3]

Fotheringham's investigation of the overlap between spatial categories of 'audience space' and 'actor space' are also pertinent to performance today:

If [today] a member of the audience did venture onto the margins of the stage and claimed the right to remain there and disrupt the performance (almost unthinkable, unless drunk), it is the ***management*** *which would have to deal with the problem, not the actors (though they might well be annoyed and decide to intervene less formally). This is not a space that the actors and playwrights currently own, legally or imaginatively, nor do we as audiences see any area other than that assigned to us as even possibly being able to be occupied.* (emphasis added) [3]

While Fotheringham used the model to answer his specific research questions, the questions about theatre and cultural spaces are somewhat broader. There appear to be

five main factors for analysing cultural spaces. It is possible to look at them through an Ortelia lens to think about how we might pursue answers to them such spatial connections between galleries, museums and theatre:[12]

1. The basic requirement of a space: an exhibition, like a play, needs to take 'place' somewhere, even if not in a conventional venue
2. The capacity for creating, reflecting, communicating, and even manipulating 'culture' (or perhaps versions of 'culture')
3. The significance of the visual
4. The requirement of an audience: when all three face losing audiences to the immediacy of film and the internet, among other competing forces for entertainment money and time.[13]
5. The context of a body in space: what happens in/to a space when it is 'activated' by a body?

In each case, there is a level of abstraction required to see the *use* of this space: we are able to investigate *differently* questions about how cultural space operates, including how memory, representation, and culture are communicated in these contexts.

First, the requirement of a 'space' is a given for any type of cultural event. Such technology helps foreground the fundamental nature of that space as much as it focuses on objects or images. It helps to articulate and make practical Lefebvre's point that "*space is never empty: it always embodies a meaning*" [1]. An Ortelia environment helps uncover and document the 'archaeology' of performance and performance spaces. This is particularly true of the theatre building which carries traces of past performances, and even past lives of the building or site. Further, an environment like an Ortelia theatre can facilitate a study of space over time; in examining how venues change, Ortelia captures spatial and/or geographical information better and more comprehensively than conventional historiography. In the case of the Boar's Head model, Ortelia permits a re-historicisation as it returns us to early modern London in a spatial format that holds a greater deal of certainty than theatre historians have had to date. Ortelia thus permits the 'fixing' of space so that when a performance (or exhibition) finishes, its traces are much more significant, accessible and even palpable than they might otherwise be.

Second, museums, galleries and theatre don't merely reflect or communicate cultural significance: they have the capacity to influence, produce or constitute culture. The raison d'être of art and theatre is to create something that affects its community. Museums not only construct social meaning; they also articulate, shape, and influence

[12] Of course there are differences too: for Hooper-Greenhill, "Museums pride themselves on being places where 'real objects' can be seen. This notion of 'the real' is a powerful and enduring one" [4]. The question of 'real' and 'authenticity' emerge in galleries and exhibitions, but it tends not to be an issue in theatre.

[13] Witcomb cites many museum critics who argue that the relationship between museums and their audiences "is one of the most pressing issues facing museums today" [5]. Audience maintenance and generation are at the core of many decisions in theatre programming.

culture, as Tony Bennett and Eilean Hooper-Greenhill, among many others, argue.[14] The prominence of both memory and representation in all three art forms suggests that they look back to the past while creating a path for the future. And theatre, art, and museum collections can contribute to a visitor's understanding that these terms are all culturally-relative and culturally-coded as well.

The capacity to create and influence culture can be explored more plastically with Ortelia than with 'real world' counterparts. While Ortelia permits the fixing of space, paradoxically, it paradoxically also demonstrates the *malleability* of specific cultural spaces. This malleability is less often associated with space which (if thought of at all) is generally considered to be immovable. The VR version of recognisable places of cultural capital can be manipulated by the average user in a way that is not generally possible with actual theatres, galleries, or museums: more radical interaction with the architecture of a venue – moving walls, putting in sky-lights, adding new wings – is possible if those constructing a modelled space wish it to be used in such a way. The generation of meanings about a culture can be made more directly by its citizens who already use internet-based social networking technology.

The Boar's Head model provides a glimpse of the function of Elizabethan stages in the context of both early modern theatre *and* twenty-first century theatre, if we look at it while taking into account the first two points (the significance of *fixing* space while also providing the potential for *manipulating* space). Fotheringham notes that the way the audience has responded to the edge of the stage in the contemporary Globe theatre in London has changed even since 1997; this suggests that charting the use and function of a cultural venue like a theatre over time is well-worth documenting, as a means to develop arguments about performance methods, among other spatial and theatrical factors.

Third, space is inextricably associated with notions of the visual: James Kneale argues that "*Visual culture is consumed in spaces*" [7]. Nick Mirzoeff maintains that the 'visual' is what enables the connection between the real and the virtual.[15] The visual can be relevant in a new way for museums in particular: in addition to recreating lost theatres, projects like Ortelia can help repatriate objects, at least virtually. A piece that exists in a collection overseas may be exhibited in a virtual context, once a venue is modelled. Equally, it is a relatively easy process to recreate pieces that have been lost, scattered, stolen, destroyed: we can reconstruct objects of cultural heritage that no longer exist, or that do not remain with other items with which they were once located. Modelling accurate representations of items and locating them in appropriate environments is no longer just speculative, and the *re*-placement of items in an originary site generates a very different experience of culture. The repatriation of

[14] See Hooper-Greenhill's perspective: The construction of meaning is partly shaped by prior knowledge and experience, and by how the past is related to the present. All interpretation is necessarily historically situated. Position in history and culture affects meaning. Meaning is constructed through and in culture. Perception, memory and interpretation are cultural constructs [4]

Bennett notes that "Museums, galleries, and, more intermittently, exhibitions played a pivotal role in the formation of the modern state and are fundamental to its conception as, among other things, a set of educative and civilizing agencies" [6].

[15] He notes: "the real and the virtual are now imbricated, mediated by the visual image" [8].

indigenous items is a much more sensitive issue, politically and culturally. There are many other matters to consider here, particularly the risk of what's been called 'cyber-colonialism.'[16] A virtual repatriation project could develop cultural space such that the VR environment *augments* the 'real.' This form of 'supplement' *reminds* us what is lost, rather than *replacing* what is lost. As a means of circumventing lengthy cultural and political battles about ownership, digital repatriation could provide some semblance of cultural continuity *and* opportunities for speculation about relationships with different (cultural) spaces.

While the first three points deal with different aspects of spatiality itself, the fourth and fifth points introduce factors outside the strictest purview of 'space': audiences and actors. Regarding the fourth point, theatre, galleries, and museums share the requirement of a community context which relies upon an audience. The space for a community to come together to reflect on itself operates very differently today than it did in earlier centuries where, particularly in Europe, public squares functioned as a means of social and political interaction, reinforcement, and change.[17] Today, different forms of social networking exist, from *Idol* and television programs that involve audience voting to personal networking sites like Facebook. Interactivity is a fundamental aspect of contemporary visual culture, according to Mirzoeff, who values any form of interactivity in which the user controls the path: such opportunities take the user "*beyond the traditional picture space, even if it inevitably retains the three-dimensional space of traditional geometry*" [8].[18] Interactivity augments the role of the user, who is no longer just the recipient of visual stimuli. The user's subject position is now changed; as Andrew Darley notes in the context of computer gaming, "*the player also becomes a doer*" [10], and this 'doing' can take the form of altering and shaping public cultural space. More crucially, Chris Jenks points out that users relate their experience with interactive visual culture to learning "*how to read the world*" [11]. Certainly audiences are increasingly being encouraged back into museums and galleries by interactive activities – however they may be defined.

The final point is the place of performers or the performing body: while Lefebvre argues that space precedes culture, space means little if human intervention and/or agency in the context of space is overlooked. The reverse can also be true: the body also requires 'space.' Ortelia's work on space has, so far at least, focused on space to the exclusion of the human agent, because space is in itself such a large topic, but Delbridge's research in the motion-capture of humans and objects: we are trialling the

[16] I am indebted to Paul Turnbull for this concept.

[17] See Light and Smith who argue that the public square was where, "according to Bakhtin, history is enacted" [9]. They assert that a "healthy public square, or sphere […] foster[s] a form of democracy in which issues emerge from, and are clarified by, this sort of public debate" [9]. Crucially, these spaces "decide the meaning and value of abstractions such as monetary policy, public responsibility, individual rights, national identity, immigration policy, community solidarity. Public spaces are the citizen's testing ground of social theories and political ideals" [9]. They have, then, discursive potential, not just practical dimensions, even as they change today with the popularity of 'public' sites of social networking on the internet.

[18] He does note that interactivity in cultural spaces is hardly new, citing dioramas and other interactive elements have been part of museums for over one hundred years [8].

placement of his examples of motion-capture into Ortelia environments. This is just the beginning of how we might think about some of the questions raised when the human body interacts with space in real time.

The development of a body performing across time and in multiple spaces is just one of the directions which we can follow. Once we introduce motion and performance capture into the scenario we invariably open up a new set of possibilities for the exploration of space and spatial management. This potential for this works in two parts: we explain the first and speculate about the second.

The first is in the use of pre-recorded mocap data that can be used to 'populate' the cultural space enabling the exhibition arena to be viewed from within a simulated 'peopled' perspective. This data can be captured in such a way as to be site- and installation-specific to the area by loading the 3D assets of a commissioned Ortelia environment (both spatial parameters and the specific artworks and/or artefacts) into a MotionBuilder© environment that allows for both the Ortelia 3D assets and captured Mocap data loaded on to neutral avatars to coexist in the same space. These avatars need not necessarily be passive within the space and can have specific relational characteristics applied to them. This means that it is possible to manipulate the spatial relations between specific Mocap markers and either the end user interface or indeed any other 3D object within the environment can trigger certain reactions and behaviours. The addition of pre-recorded mocap data allows for a limitless combination of real-life scenarios to be played out within a particular cultural institution. This data would even enable the managers of cultural venues to plan exhibitions to allow for the flows of patrons during peak periods; they would be able to estimate more accurately (and in advance) how much room around particular pieces is required to prevent over-crowding at popular works. Beyond issues of potential congestion within areas of the modelled institution, such combinations of VR environments with mocap highlight the potential for predicting required changes in the "hang" and lighting of artworks.

Populating the asset area also increases the potential for visitors to spend more time at each individual work in a virtual environment because the programming will allow for areas around certain works to be busy at certain times (to reflect the actual social context of the environment) and then freer at other times (to enable the better enjoyment of an environment in virtual form). Again this can all be programmed into the system using the spatial relational characteristics that can be applied to avatars (or markers that drive avatars) within MotionBuilder©. The avatars thus become a living, activated part of the Ortelia model, potentially as much a part of the experience of the gallery/museum as the works to be viewed themselves. The inclusion of the activated avatar (as opposed to the passive spectator avatar in the current Boar's Head Model) also facilitates an overall activation of space that then allows the virtual visitor the opportunity to still be within the environment but, at the same time, to view how others interact within the pre-recorded and modelled system. The mocap performers are able to locate themselves within the Ortelia environment in real-time and actively participate in the modelled cultural space, with the assistance of a 12 camera Vicon optical motion capture system with a mixture of wide and narrow lenses feeding into a live viewing window within MotionBuilder© that reads the 40 marker set template in real time. The main issues to

date are all concerned with scale, with the ultimate real-time environment to capture actually being the real gallery or museum, with a larger mocap system installed to track the real movement of performers within the space.

There are several benefits to the use of Motion Captured animation in Ortelia environments as opposed to scratch animated characters/avatars. The first is obviously the economic factor; for an animator to create individualized movement and action for several avatars would take several weeks, whereas in a mocap shoot all of that data can be captured in a day, cleaned within a week and solved on to the avatar for a fraction of the cost. The second advantage is concerned with the ultimate realistic nature of the movement, individuality and gravity (or weight) that is present in the data captured from a real human in a Mocap session. It is also possible under the right conditions for several individuals to be captured at once in a session, and of particular importance to the potential of the system already described, for this group of individuals to be streamed in real-time into a MotionBuilder© workspace so that the captured individuals can then respond to the 3D Ortelia environment as part of the capture. The third point about using mocap data within the Ortelia system is the limitless potential to exploit the relational possibilities between individual markers and/or objects within MotionBuilder© and other software applications. The motion-captured data (subsequently turned into 3D objects and avatars) can allow for a series of relationships to be created in 3D space that can in turn be allocated behaviours that will react (as per programming) when the relationship is triggered. Put simply, these relationships are spatial and can be used to trigger audio and visual responses when activated; they can also be used to allow the viewer to move through a crowd at a popular exhibition, to trigger an information panel to appear when the viewer is within a certain distance of an artwork, or to elicit a physical and/or aural response from other avatars who have populated the environment.

The second potential for the use of Motion Capture in Ortelia remains at this stage untested, although in theory it will work, based on connection speeds and stable mocap streamed data. It is concerned with the viewer of the 3D cultural space interacting with the environment in real-time while being streamed from a mocap environment into the Ortelia landscape. This idea is of particular interest with relation to the Boar's Head model to simulate and examine the performance experience for actors on such an early modern stage. Presuming that the same activated (but pre-recorded) avatars would populate the audience at the Boar's Head, the real-time performer will be able to interact and elicit responses from the audience based on pre-programmed relational settings, while also allowing the 'actor' to experience the stage in all of its permutations. By allocating a virtual camera to a certain marker on the real-time streamed performer, MotionBuilder© will enable the performer to see the view from the stage and literally (and virtually) perform to the peopled audience.

There is one more matter that has emerged in regard to the potential of virtual reality as a research tool in the context of cultural spaces: that is the place, as it were, of the 'real' and the 'unreal.' One of the attractions of Ortelia is its foregrounding of the space of the real, even if it is in the guise of being 'not real.' That is, Ortelia is not real, even though its rendering of space and images (and, with the motion capture files, people

behaviour as well) is as realistic as possible. Ortelia acts as a supplement to the real since these VR models have little meaning without the existence of the corresponding 'real' cultural space.

There are several challenges that Ortelia is pursuing: these include the generation of spaces that are not possible for the average citizen to visit. These may include 'real' spaces such as the backstage area of a theatre, or the storage sections of museums and galleries. They also include places that are suggested by a cultural venue, even if it is not possible for any citizens to 'visit'; there is the potential to generate new wings for a gallery, or a different 'look' to the architecture for a museum. Of course this can also incorporate the 3D creation of set designs in theatre (and the *re*-creation of historical set designs in 3D, based on photographic – that is, 2D – evidence). The design of more function tools, such as a curation tool for galleries and exhibitions, is underway. We are also intrigued by the possibilities that there are further 'spaces' to explore in art and museums: several of the characters in the old Disney *Mary Poppins* movie 'entered into' chalk drawings, as one would enter into a gallery. The recreation – and, paradoxically, also the 'creation' – of such locations is an exciting avenue for the future.

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